

**PATENT**

Peters Verny Jones & Schmitt Docket No. 5002.04  
Customer No. 23308

Ser. No. 09/977,069

**Amendments to the Claims:****Listing of Claims:**

- 1-5. (Canceled)
6. (Currently amended): A semiconductor device comprising:
  - (a) a substrate;
  - (b) a diffusion barrier, wherein the diffusion barrier comprises a self-assembled monolayer including a plurality of molecules, each molecule having an aromatic group at the terminus of the molecule and each molecule further having a trimethoxy silane group; and
  - (c) a metal layer comprising copper on the diffusion barrier, wherein for each molecule in the plurality of molecules, the copper in the metal layer is in direct contact with the aromatic group of the molecule,  
wherein the diffusion barrier is capable of preventing the diffusion of copper atoms from the metal layer into the substrate when the semiconductor device is exposed to thermal annealing at 200 °C or an electric field of 2 MV/cm at 200 °C in flowing N<sub>2</sub>.
7. (Previously presented): The semiconductor device of claim 6 wherein the substrate comprises silicon oxide on silicon.
8. (Previously presented): The semiconductor device of claim 6 wherein each molecule comprises a linear carbon chain having at least 2 carbon atoms.
9. (Previously presented): The semiconductor device of claim 6 wherein the metal layer is formed by a vapor deposition process.
10. (Canceled)

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11. (Previously presented): The semiconductor device of claim 6 wherein the diffusion barrier coats the walls of a hole in the substrate and wherein the metal layer fills the hole.
12. (Canceled)
13. (Currently amended): A semiconductor device comprising:
  - (a) a semiconductor substrate;
  - (b) a diffusion barrier, wherein the diffusion barrier comprises a self-assembled monolayer including a plurality of molecules, each molecule having a linear chain at least two atoms long, [[and]] an aromatic group at the terminus of the molecule, a trimethoxy silane group; and
  - (c) a metal layer comprising copper on the diffusion barrier, wherein the metal layer is formed by a vapor deposition process, and wherein the copper in the metal layer is in direct contact with the aromatic group of each molecule in the self-assembled monolayer,  
wherein the device does not exhibit  $j_{\text{leakage}} > 1000 \text{ nAcm}^{-2}$  when the semiconductor device is exposed to thermal annealing at 200 °C or an electric field of 2 MV/cm in flowing N<sub>2</sub> at 200 °C for up to 650 minutes.
14. (Previously presented): The semiconductor device of claim 13 wherein the substrate comprises silicon oxide on silicon.
15. (Currently amended): The semiconductor device of claim 13 wherein each molecule comprises a linear carbon chain having ~~at least~~ 2 carbon atoms.
16. (Previously presented): The semiconductor device of claim 13 wherein the metal layer is formed by a sputtering process.
17. (Previously presented): The semiconductor device of claim 13 wherein the diffusion

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barrier is capable of preventing the diffusion of copper atoms from the metal layer into the substrate when the semiconductor device is exposed to thermal annealing at 200 °C.

18. (Previously presented): The semiconductor device of claim 13 wherein the substrate comprises silicon oxide on silicon.

19. (Canceled)